SECURITY CLASSIFICATION OF THIS PAGE

AD-A216 030

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Unclassified/Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): ONR Technical Report #18	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: Dept. of Chem. Eng. & Mat. Sci. Corrosion Research Center; 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION: Office of Naval Research
6c. ADDRESS (City, State, and ZIP Code): University of Minnesota, Minneapolis, MN 55455	7b. ADDRESS (City, State, and ZIP Code): 800 North Quincy Street, Arlington, VA 22217-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: DARPA/ONR; 8b. OFFICE SYMBOL (If applicable): Code 1113	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: Contract No. N00014-88-K-0360
8c. ADDRESS (City, State, and ZIP Code): 800 North Quincy Street, Arlington, VA 22217-5000	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

Performance of Superconductive Oxides as Cathodes for Lithium Rechargeable Batteries

12. PERSONAL AUTHOR(S) B.B. Owens, M.Z.A. Munshi, P.S.S. Prasad, W.H. Smyrl, W. Kinzy Jones, J.B. Schlenoff and H.F. Wu

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Technical	FROM 7/88 TO 10/89	89/10/23	

16. SUPPLEMENTARY NOTATION

Published in the Extended Abstracts of the 30th Battery Symp., Nagoya, Japan, 10/27-29/89

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Li battery, insertion cathode, yttrium barium copper oxides, non-aqueous cell, (SDW)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The superconducting oxides, yttrium barium copper oxide (A) and neodymium copper oxide (B) were fabricated into cathodes for lithium nonaqueous batteries. The cathode limited cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in propylene carbonate or 2-methyl-tetra-hydrofuran and were hermetically sealed in stainless steel case-positive cans. The initial open circuit potentials were in the range of 3.0-3.5 volts for all cell types. The potentials of both type A and B cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that have been prepared in an N_2 atmosphere. Cycle and capacity test results are presented. Keywords.

89 12 19 052

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION: Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL: Boone B. Owens and William H. Smyrl	22b. TELEPHONE (Include Area Code): (612) 625-4048; 22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

PERFORMANCE OF SUPERCONDUCTIVE OXIDES AS CATHODES FOR LITHIUM RECHARGEABLE BATTERIES

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The superconducting oxides, yttrium barium copper oxide (A) and neodymium copper oxide (B) were fabricated into cathodes for lithium nonaqueous batteries. The cathode limited cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in propylene carbonate or 2-methyl-tetrahydrofuran and were hermetically sealed in stainless steel case-positive cans. The initial open circuit potentials were in the range of 3.0 - 3.5 volts for all cell types. The potentials of both type A and B cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that have been prepared in a N_2 atmosphere. Cycle and capacity test results are presented.

1. INTRODUCTION

The possibility of utilizing superconducting oxides as the electropositive electrode in nonaqueous lithium batteries was recently described by Jones[1] who reported the discharge of a primary cell

$$Li/1M\ LiClO_4,\ 1,3\ dioxolane/YBa_2Cu_3O_7 \qquad (I)$$

Jones reported the apparent insertion of 0.87 Li^+ into the cathode at 25°C, with no effect on the superconductive transition temperature.

2. EXPERIMENTAL

We have further investigated these reactions for cell systems that may be rechargeable in order to assess the reversibility of the ion insertion, assuming that the discharge mechanism is not a decomposition type of reaction. The superconducting oxides, yttrium barium copper oxide ($YBa_2Cu_3O_7$) and neodymium copper oxide ($Nd_2CuO_{4-x}F_x$) were synthesized by procedures described by Jones[1] and James[2], respectively.

These oxides were fabricated into cathodes for lithium nonaqueous batteries that contained a large excess of lithium. The cells had electrolytes of 1M $LiClO_4$ or $LiAsF_6$ in 2-methyltetrahydrofuran (THF), or 1, 3 dioxolane (DOL). The cells were fabricated in a 2% relative humidity dry room under controlled environmental conditions and were hermetically sealed in stainless steel case-positive cans. The design was essentially the same as described by

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Jones[1]. In addition to cell type I, the following cells were also investigated:

$$Li/1M\ LiAsF_6,\ THF/YBa_2Cu_3O_7 \qquad (II)$$

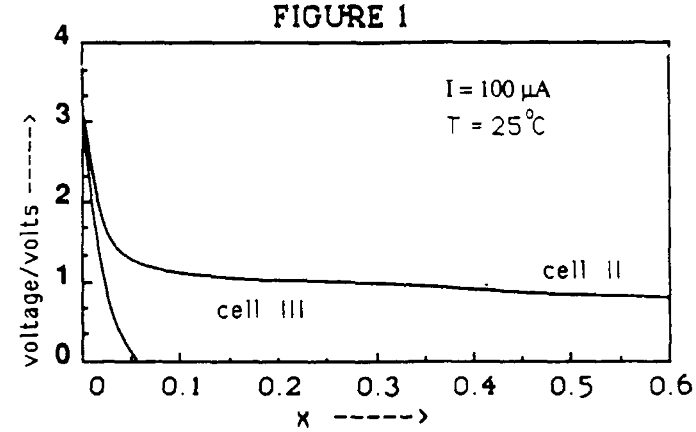
$$Li/1M\ LiAsF_6,\ THF/Nd_2CuO_{4-x}F_x \qquad (III)$$

3. RESULTS

The initial open circuit potentials were in the range of 3-3.5 volts for all cell types. The potentials of those cells with oxides prepared in an atmosphere of O_2 were about 200 mV greater than those for cathodes that had been prepared in a N_2 atmosphere.

Cells II and III were discharged under identical conditions, at a rate of 100 microamps. Up to 0.75 lithium ions inserted into the $YBa_2Cu_3O_7$, but only 0.03 lithium ions inserted into the $Nd_2CuO_{4x}F_x$, as shown in Figure 1. The cell II was cycled at x = 0.04 and demonstrated reversible behavior. Further tests are in progress to identify the nature of the discharge products for these cell systems.

FIGURE 1



ACKNOWLEDGEMENT

The authors wish to acknowledge the financial support from the Office of Naval Research and the Defense Advanced Research Projects Agency.

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2. James et al. Nature, 338, 240 (1989).